

Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) An optical information recording and reproducing apparatus for recording information in and reproducing information from an optical information recording medium having an information recording layer in which information is recorded utilizing holography in the form of an interference pattern as a result of interference between information light carrying the information and reference light for recording having a spatially modulated phase, the apparatus comprising:

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information light generation means for generating information light carrying information;

recording reference light generation means including phase modulation means for spatially modulating the phase of light, for generating reference light for recording having a phase spatially modulated by the phase modulation means; ~~and~~

a recording optical system for illuminating the information recording layer on the same side thereof with the information light generated by the information light generation means and the reference light for recording generated by the recording reference light generation means such that the information is recorded in the information recording layer in the form of an interference pattern as a result of interference between the information light and the reference light for recording;

reproduction reference light generation means including phase modulation means for spatially modulating the phase of light in the same manner in which the reference light was modulated when the information was recorded, for generating reference light for reproduction having a phase spatially modulated by the phase modulation means;

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a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and
detection means for detecting the reproduction light collected by the reproducing optical system.

2. (Currently Amended) ~~An~~The optical information recording and reproducing apparatus according to claim 1, wherein the optical information recording medium has a positioning region for recording information for positioning the information light and the reference light for recording, the apparatus further comprising position control means for controlling the positions of the information light and the reference light for recording relative to the optical information recording medium using the information recorded in the positioning region.

3.-5. (Cancelled).

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6. (Currently Amended) An optical information recording and reproducing method for recording information in and reproducing information from an optical information recording medium having an information recording layer in which information is recorded utilizing holography in the form of an interference pattern as a result of interference between information light carrying the information and reference light for recording having a spatially modulated phase, the method comprising the steps of:

generating information light carrying information;

spatially modulating the phase of light to generate reference light for recording having a spatially modulated phase; ~~and~~

illuminating the information recording layer on the same side thereof with the information light and the reference light for recording to record the information in the information recording layer in the form of an interference pattern as a result of interference between the information light and the reference light for recording;

spatially modulating the phase of light to generate reference light for reproduction having a spatially modulated phase modulated in the same manner in which the reference light was modulated when the information was recorded;

illuminating the information recording layer with the reference light for reproduction and collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and detecting the collected reproduction light.

7. (Currently Amended) An optical information reproducing apparatus for reproducing information utilizing holography from an optical information recording medium having an information recording layer in which the information is recorded in the form of an interference pattern as a result of interference between information light carrying the information and reference light for recording having a spatially modulated phase, the apparatus comprising:

reproduction reference light generation means including phase modulation means for spatially modulating the phase of light, for generating reference light for reproduction having a phase spatially modulated by the phase modulation means in the same manner in which the reference light was modulated when the information was recorded;

a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording

layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and detection means for detecting the reproduction light collected by the reproducing optical system.

8. (Currently Amended) ~~An~~The optical information reproducing apparatus according to claim 7, wherein the optical information recording medium has a positioning region for recording information for positioning the reference light for reproduction, the apparatus further comprising position control means for controlling the position of the reference light for reproduction relative to the optical information recording medium using the information recorded in the positioning region.

9.-15. Cancelled.

16. (Currently Amended) An optical information reproducing apparatus for reproducing information utilizing holography from an optical information recording medium having an information recording layer in which the information is recorded in the form of an interference pattern as a result of interference between information light having a wavelength selected from among a plurality of wavelengths and carrying the information and reference light for recording having the wavelength selected from among a plurality of wavelengths, the apparatus comprising:

wavelength selection means for selecting a wavelength of light illuminating the information recording layer from among a plurality of wavelengths;

reproduction reference light generation means for generating reference light for reproduction having the wavelength selected by the wavelength selection means said reproduction reference light generation means including modulation means for spatially modulating the phase of the reproduction reference light in the same manner in which the reference light was modulated when the information was recorded;

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a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

detection means for detecting the reproduction light collected by the reproducing optical system.

17. (Currently Amended) ~~An~~The optical information reproducing apparatus according to claim 16, wherein the optical information recording medium has a positioning region for recording information for positioning the reference light for reproduction, the apparatus further comprising position control means for controlling the position of the reference light for reproduction relative to the optical information recording medium using the information recorded in the positioning region.

18.-50. Cancelled.

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51. (Currently Amended) An optical information recording and reproducing apparatus for recording information in and reproducing information from an optical information recording medium having an information recording layer in which information is recorded utilizing holography, the apparatus comprising:

an information light generator that generates information light by first modulating a first light based on first information;

recording reference light generator that modulates a second light to generate a reference light based on second information; ~~and~~

a recording optical system for illuminating the information recording layer with the information light and the reference light, the information light and the reference light illuminating the information recording layer on a same side such that the first and second

information is recorded in the information recording layer as an interference pattern between the information light and the reference light;

reproduction reference light generation means including phase modulation means for spatially modulating the phase of light, for generating reference light for reproduction having a phase spatially modulated by the phase modulation means in the same manner in which the reference light was modulated when the information was recorded;

a reproducing optical system for illuminating the information recording layer with the reference light for reproduction generated by the reproduction reference light generation means and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

detection means for detecting the reproduction light collected by the reproducing optical system.

52. (Currently Amended) ~~An~~ The optical information recording and reproducing apparatus according to claim 51, further comprising:

a position controller that positions the information light and the reference light on the optical information recording medium based on positioning information in the optical information recording medium.

53. (Currently Amended) ~~An~~ optical information recording and reproducing apparatus according to claim 51, wherein the recording reference light generator performs one or more of spatially modulating the second light and phase modulating the second light to generate the reference light.

54. (Currently Amended) An optical information recording and reproducing method for recording information in and reproducing information from an optical information recording medium having an information recording layer in which information is recorded

utilizing holography in the form of an interference pattern as a result of interference between information light carrying the information and reference light for recording having a spatially modulated phase, the method comprising:

generating information light carrying information;

generating reference light;

modulating the reference light; ~~and~~

illuminating the information recording layer with the information light and modulated reference light on a same side of the optical information recording medium; ~~and~~

recording the information in the information recording layer as an interference pattern between the information light and the modulated reference light;

spatially modulating the phase of light to generate reference light for reproduction having a spatially modulated phase in the same manner in which the reference light was modulated when the information was recorded;

illuminating the information recording layer with the reference light for reproduction and collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

detecting the collected reproduction light.

55. (Currently Amended) ~~An~~The optical information recording and reproducing method according to claim 54, wherein the modulating is one or more of spatially modulating and phase modulating.

56. (Currently Amended) An optical information reproducing apparatus for reproducing information utilizing holography from an optical information recording medium having an information recording layer in which the information is recorded in the form of an

interference pattern between information light carrying the information and reference light,
the apparatus comprising:

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a reference light generator that spatially modulates the phase of light to
generate reference light in the same manner in which the reference light was modulated
during recording; and

a reproducing optical system that illuminates the information recording layer
with the reference light and collects, from a same side of the information recording layer that
is illuminated, reproduction light emanating from the information recording layer.

57. Cancelled.

58. (Currently Amended) ~~An~~The optical information reproducing apparatus
according to claim 56, further comprising a position controller that positions the reference
light on the optical information recording medium based on position information in the
optical information recording medium.

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59. An optical information recording-~~and~~ reproducing apparatus for recording
information in an optical information recording medium having an information recording
layer in which information is recorded utilizing holography and for reproducing the
information from the optical information recording medium, the apparatus comprising a pick-
up device disposed on a side of the optical information recording medium, the pick-up device
having:

a light source for emitting light;

an information light generator that spatially modulates a first portion of the
light based on the information;

a reference light generator that generates a first reference light for recording
and a second reference light for reproduction from a second portion of the light, wherein the
modulation means modulates the phase of second reference light for reproduction in the same

manner in which the first reference light for recording was modulated when the information was recorded; and

an optical system that illuminates the side of the information recording layer with the information light and the first reference light to record the information in the information recording layer as an interference pattern between the information light and the first reference light, and that illuminates the information recording layer with the second reference light and collects reproduction light emanating from the side of the information recording layer when illuminated with the second reference light.

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60. (Currently Amended) ~~A~~The optical information recording/ and reproducing apparatus according to claim 59, wherein the first reference light is one or more of spatially modulated and phase modulated to record the information and the second reference light is modulated in substantially a same way as a reference light used to record the information that is to be reproduced.

61.-78. Cancelled.

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79. (Currently Amended) An optical information recording and reproducing apparatus for recording information on and reproducing information from an optical information recording medium having an information recording layer in which information is recorded utilizing holography in the form of an interference pattern as a result of interference between information light carrying the information and reference light for recording having a spatially modulated phase, the apparatus comprising:

an information light generation unit configured to generate plural information lights each which carries corresponding two dimensional pattern information;

a recording reference light generation unit, including a phase modulator for spatially modulating a phase of light, configured to generate plural reference lights for

recording each which is spatially modulated by said phase modulator in response to a unique phase modulation pattern for said each two dimensional pattern information;

an optical recording unit configured to illuminate said information layer with said plural information lights and said plural reference lights for recording so that an optical axis of each information light and an optical axis of the corresponding reference light for recording are located on the same line, to perform a multiplex recording to record on the same location of said optical information recording medium information in the form of plural interference patterns as a result of interferences between said plural information lights and said plural reference lights for recording;

a reproduction reference light generation unit, including phase modulator for spatially modulating the phase of light, configured to generate plural reference lights for reproduction each which is spatially modulated by said phase modulator in response to a unique phase modulation pattern for said each two dimensional pattern information in the same manner in which the reference light was modulated when the information was recorded;

an optical reproducing unit configured to illuminate the information recording layer with the reference light for reproduction generated by the reproduction reference light generation unit and for collecting reproduction light generated at the information recording layer when illuminated with the reference light for reproduction on the same side of the information recording layer that is illuminated with the reference light for reproduction; and

a detection unit for detecting the reproduction light collected by the optical reproducing system.

80. (Currently Amended) The optical information recording and reproducing apparatus according to claim 79, wherein said optical recording unit performs said multiplex recording so that recording locations adjoining each other are overlapped in part in a certain direction on said optical information recording medium.

81. (Currently Amended) The optical information recording and reproducing apparatus according to claim 79, wherein said optical recording unit records a same interference pattern on plural locations of said optical information recording medium.

82. (Currently Amended) The optical information recording and reproducing apparatus according to claim 79, further comprising:

a two dimensional pattern information generation unit configured to generate said two dimensional pattern information by dividing information to be recorded into plural pieces of data,

wherein said optical recording unit performs said multiplex recording of said plural interference patterns spreading over plural locations on said optical information recording medium in a predetermined order.

83. (Currently Amended) The optical information recording and reproducing apparatus according to claim 82, further comprising:

a parity generation unit configured to generate parity data based on said two dimensional pattern information,

wherein said optical recording unit records on said optical information recording medium plural interference patterns corresponding to said parity data based on a predetermined rule.

84. (Currently Amended) The optical information recording and reproducing apparatus according to claim 83,

wherein said parity generation unit generates plural sets of parity data corresponding to plural sets of said two dimensional pattern information, and

said optical recording unit records all interference patterns corresponding to said plural sets of parity data on one location on said optical information recording medium.

85. (Currently Amended) The optical information recording and reproducing apparatus according to claim 83,

wherein said parity generation unit generates plural sets of parity data corresponding to plural sets of said two dimensional pattern information, and

said optical recording unit records plural interference patterns corresponding to said plural sets of parity data spreading over plural locations, on each which includes an interference pattern corresponding to at least one of said plural sets of parity data.

86.-95. Cancelled.